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MODEL OF INVESTMENT IN ROAD MAINTENANCE AS PRESERVATION OF ROAD INFRASTRUCTURE VALUE

ABSTRACT

The aim of research is to indicate the failure to use information on road depreciation in the process of making decisions about investment into road maintenance. Depreciation as accountancy category has not been sufficiently used as managerial information and its status has been marginalised. A big problem is also the non-defined status of "emergency" maintenance which some legal subjects responsible for road management book as investment maintenance which is used to compensate for the road value, and some as expenditure, in which case the mentioned investments do not even enter the base for depreciation calculation.

In writing this paper the data about the book road value were taken into consideration, the amount of depreciation as well as the data about investments into the maintenance on state roads in the period from 2001 to 2008.

In data analysis the methodology of descriptive statistics and regression analysis have been implemented.

The results of the study of correlation between the value of depreciation and the investment into emergency maintenance have shown that the investment amount is at the level of 74% of the depreciation amount, which indicates the underestimated depreciation rate regarding the fact that roadway condition evaluations are not in harmony with such investment.

KEY WORDS

road depreciation, periodic maintenance, road value, road management

1. INTRODUCTION

The influence of traffic and traffic infrastructure on the economic development is not questionable, but the problem is integral covering of effects, their measuring and evaluating. The main indirect effects of the construction of infrastructure (roads) are reflected in their acting on the changing of the economy structure, development of underdeveloped areas, economy efficiency, and cultural and social development.

The globalisation process imposes the acceptance and development of internationally recognised standards of behaviour and management. Over the recent years the accountancy in the government sector has become an active factor of the process in the public sector. The government, who is the decision-maker in the public sector, needs good information that may be the result only of correctly selected accountancy concept since it determines and pre-determines the content and quality of accountancy information [1].

Regarding the significance of public consumption and the aim to realise the set goals with minimal costs, in order to enable future fiscal discharge of the population, today there is an increasing need for its transparency. Since the application of different accountancy concepts of recognising business events in the public sector results in different information, this area today is in the focus of research of many scientists in the world. The reform of public sector means the introduction of economic laws and the rules of good management.

The issue of road depreciation was last analysed in the material provided by the Institute for Public Finances under the title: "Depreciation of Road Infrastructure in SR Croatia" in 1987 [2].

Road depreciation received different treatments during certain periods of time. The reason is the historical development itself of road organisation and financing, and the public sector itself and the influence of public expenditures on the economic growth

has been more significantly studied by the scientists only over the last fifty years [3]. Parallel with the change of road management organisation and the financing method, the accountancy system changed as well and since in the public sector there are no criteria of measuring the success of business results, as a category, depreciation could not have played any major role.

The European system of National Accounts from 1979 (ESA 79) did not require calculation of depreciation of public infrastructure assets (roads, bridges, etc.). The new and currently valid system (ESA 95) requires calculation of depreciation for all the produced assets that belong to the group of long-term assets [4]. Since the infrastructural, public goods are owned by the government, this provision has resulted in significant changes of GDP. The improvement of the methodology of the estimate of depreciation of public, infrastructural goods became in 2001 one of the priorities of Eurostat based on the fact that this is an item with high quantitative influence on the GDP and high significance for the comparison of relative values between states.

Defining the major elements of roads that have to be replaced or renewed within the given timeframe and by determining their duration and depreciation rate a model is being set for investing in emergency maintenance and road reconstruction. At the moment of finalizing road construction and opening the road for public use it is possible to forecast the required future investments that would maintain the road value and that would be equal to the depreciation rate. The integration of road management and the office for accounting and planning would facilitate a better flow of relevant information needed for more effective public assets management that would lead to more efficient long-term business. By building a system based on investments in the preservation of the value of the existing road network, in other words by preserving the national equity, a pattern would be created that would indicate the yearly investment priority; furthermore, a long-term coordination of physical and economic wear would review the roads service life duration.

In emergency maintenance it is not invested proportionally to the value of road depreciation, and depreciation can be one of the factors that will be the base for long-term planning of investments into road network reconstruction.

In accordance with the abovementioned research problematic a scientific hypothesis has been set on the necessity of inclusion of the amortization amount into the process of investment planning as the basis for the planning of the investment amount regarding road renovation i.e. defining the amortization as one of the relevant performances for value maintenance of the road infrastructure.

2. SIGNIFICANCE OF ROAD MAINTENANCE

Road maintenance means regular maintenance activities and road emergency maintenance activities. These activities are necessary so that the road would keep its utility value for the traffic demand for which it was designed and during its entire service life. The basic aim of maintaining and protecting roads according to the Regulations on Public Roads Maintenance and Protection[1] is to prevent road deterioration, allow safe traffic flows and reduce the users' costs by providing good road conditions.

According to the Regulations on Public Roads Maintenance and Protection (Official Gazette Nr. 25/98) regular road maintenance includes the following works:

- cleaning (roadway, drainage system, road land, equipment, etc.),
- grass mowing and removal of branches,
- renewal and applying road markings,
- painting of kilometre signs, traffic sign poles, and lighting supports,
- repair of anti-corrosive protection of protecting and other fences,
- repair and replacement of devices, equipment and traffic signalisation on the road,
- regulation of the drainage system (ditches, gutters, drainage, etc.),
- regulation of shoulders (planning and aligning),
- regulation and local repairs of the slopes of cuttings or embankments, supporting and revetment walls,
- local repairs of shoulders and kerbs,
- repairs of local roadway damages (potholes, single and block crackings, longitudinal and transverse denivelations, asphalt surfacing, flattened surfacing areas, damaged concrete roadway edges and medians),
- urgent repairs and interventions to ensure traffic flow,
- keeping roads passable in winter conditions.

Emergency road maintenance according to the Regulations on Public Roads Maintenance and Protection includes:

- repair and replacement of roadway surfacing,
- reinforcement of roadway in order to renewal and increase in driving capacity and quality,
- local repairs of roadway structure in order to protect and increase road capacity,
- road drainage system improvement,
- replacement, installation of new and enhanced vertical traffic signalisation and road equipment (kilometre and direction posts, protective fences, etc.) on larger road sections,
- repair of rockfalls, creeps and minor landslips,
- reducing of slope inclinations and other works regarding protection of slopes against erosion,

Table 1 - Average amounts for road maintenance in the period from 2001 to 2008

In euro/kilometre		No. of countries (frequencies)	Frequencies in %	Cumulative frequencies in %	Country
Bottom limit	Upper limit				
-	2,110.48	8	29.63%	29.63%	Estonia, France, Ireland, Latvia, Lithuania, Malta, Sweden, Turkey
2,110.48	4,207.12	9	33.33%	62.96%	Austria, Belgium, Czech Republic, Rumania, Slovakia, Slovenia, Island, Hungary, Portugal
4,207.12	6,303.76	3	11.11%	74.07%	Bulgaria, Luxemburg, Poland,
6,303.76	8,400.40	2	7.41%	81.48%	Finland, Croatia
8,400.40	10,497.04	2	7.41%	88.89%	Denmark, Norway
10,497.04	12,953.68	0	0.00%	88.89%	
12,953.68	14,690.32	1	3.70%	92.59%	Great Britain
14,690.32	16,786.96	0	0.00%	92.59%	
16,786.96	18,883.60	0	0.00%	92.59%	
18,883.60	20,980.24	2	7.41%	100.00%	Italy, Switzerland
Total		27			

Source: International Transport Forum [5]; authors' calculations

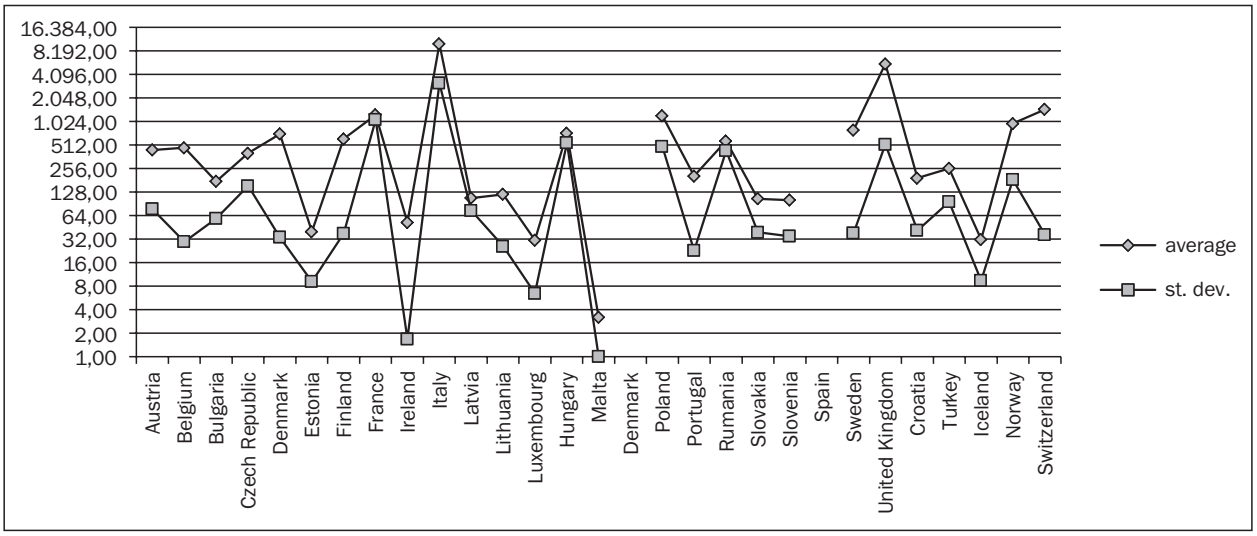
- repair of supporting and revetment walls,
- protection of roads against undermining,
- works on taking care of vegetation for biological protection of roads, landscape trimming and protection against snow drifts,
- individual corrections of geometric road elements (reduction of sharp curves, regulation of transverse inclinations, roadside turnouts etc.) in order to improve traffic safety,
- regulation of at-grade intersections (design, visibility, installation of new signalisation and equipment) excluding any major construction interventions,
- improvement of traffic conditions by taking care of roadside turnouts, rest areas, pedestrian paths, crossings in populated places, level crossings,
- repair and setting of road installations, equipment and devices.

Table 1 gives an overview of average investments into road maintenance [5] in the European countries in the time period from 2001 to 2008. The Table shows that 63% of countries invest in maintenance up to 4,200 euro per road kilometre. Only 10% of countries (Italy, Switzerland and Great Britain) invest in maintenance per road kilometre more than 1.,500 euro. Such high status of Croatia (6,646 euro per kilometre) has resulted from significant increase in investments into public road maintenance based on implementing the Traffic Development Strategy in which particular attention has been paid precisely to road maintenance. There has been substantial increase of investments into regular and emergency road maintenance which is a significant turning point in relation to previous many years of continuous neglect of road maintenance. Several EU countries (Denmark, France, Spain, Germany, Finland, Sweden, Belgium and Portugal) have carried out an analysis of spending the maintenance means which led to the conclusion that the available means represent 76 per cent of the needs.

For the period from 2001 to 2008 the average annual amount of investments into road maintenance has been presented for each country and the deviations from the calculated values (*Graph 3*). Data analysis has shown the highest change rate of road maintenance investments in France – 2.18, in Latvia – 1.31, in Hungary – 1.74, and in Romania – 1.35, whereas in other countries the annual investments increased from 1 to 15 percent. From the economic point of view, road maintenance is of extreme importance because substantial financial means have been invested in road construction, because future public expenditures are reduced, transport costs are minimised, because road users require improved service and because the number of traffic accidents is reduced. Furthermore, road maintenance insures efficient and sustainable traffic system, and is of extreme importance for the safety of road users.

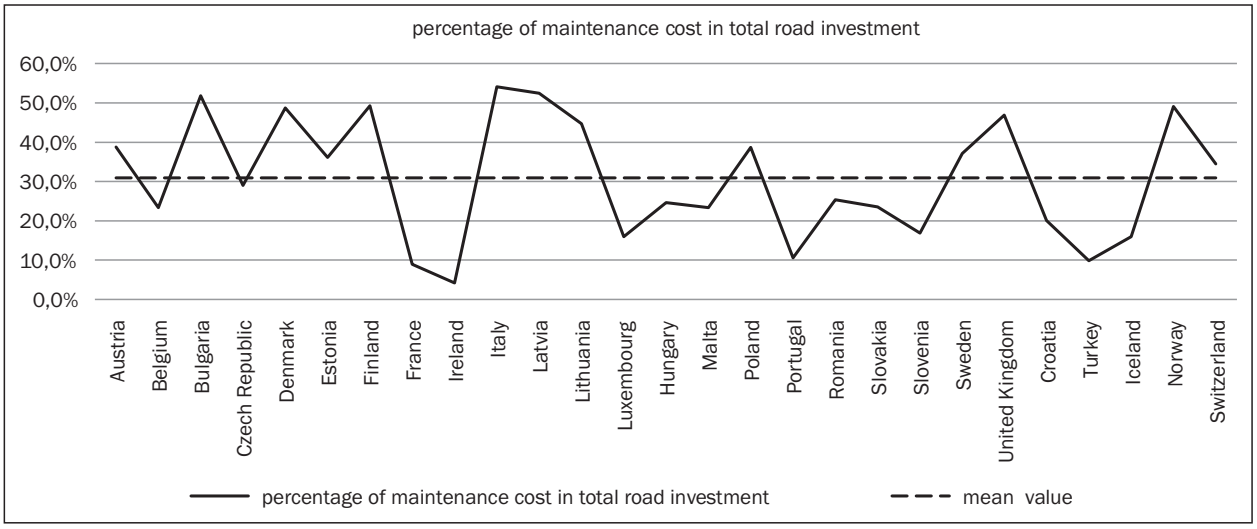
The average value of the investment share in road maintenance in overall expenditures for roads for the observed twenty-nine countries, in the observed period from 2001 to 2008 amounts to 28 percent. In Austria, Denmark, Finland, Italy, Sweden, Great Britain, Norway, the share of expenditures for road maintenance in the overall expenditures for roads ranges around 40 percent and more in the entire observed period of time.

The basic aim of maintaining and protecting roads according to the Regulations on Public Roads Maintenance and Protection [6] is to prevent road deterioration, allow safe traffic flows and reduce the users' costs by providing good road conditions.



Graph 1 - Average annual amount of investment into road maintenance and deviation from average values

Source: International Transport Forum [5]; authors' calculation



Graph 2 - Average share of expenditures for road maintenance in the total road investments

Source: International Transport Forum [5]; authors' calculation

The period from 2001 to 2010 saw a significant increase in investments into regular and emergency road maintenance in the Republic of Croatia compared to the previous period of continuous neglect of road maintenance. During the observed period the total investments into maintenance grew on the average at a rate of 14.2%, and if the year 2002 is excluded from the analysis when the growth was 80% in relation to 2001, then the growth rate for the observed period was 5.8%.

The ratio of investing into regular and emergency maintenance for state roads, during the observed period of time on the average amounts to 48.7:51.3, that is, on the average 335.31 million kuna annually were spent for regular road maintenance, and for emergency road maintenance 352.87 million kuna for ca. 7,000km of state roads.

The economic analyses of road maintenance are, unfortunately, always reduced only to relative values of realising the planned amounts and the realisation in relation to the Maintenance standard.

The obtained regression values of standard realisation for the period from 2011 to 2015 range between 61 and 62%, with the bottom value limit of 45.3%. By strategic decisions the results have been mostly planned, and by operative business plans clearly defined.

However, the question is whether the result of the calculation of the regular maintenance standard realisation is sufficient to know and measure the success and whether it represents the result of the operative business, when the form and content of the result have to be defined so as to satisfy the requirements of the methodology of measuring efficiency and effectiveness [7].

Table 2 - Estimate of the realisation of the Regular Road Maintenance Standard

years	regression values	bottom limit	upper limit
2001	31.2%	21.0%	46.3%
2002	45.2%	32.9%	61.9%
2003	51.1%	37.6%	69.5%
2004	54.3%	40.0%	73.9%
2005	56.4%	41.4%	76.8%
2006	57.8%	42.4%	78.8%
2007	58.8%	43.1%	80.3%
2008	59.6%	43.6%	81.5%
2009	60.2%	44.0%	82.4%
2010	60.7%	44.3%	83.2%
2011	61.1%	44.6%	83.8%
2012	61.5%	44.8%	84.3%
2013	61.8%	45.0%	84.7%
2014	62.0%	45.2%	85.1%
2015	62.2%	45.3%	85.5%

Source: Hrvatske ceste d.o.o., authors' calculation

There are no detailed analyses although the possibility does exist regarding big time series of data for the works for every single road. The analysis of the structure of road works, works dynamics, volume of works and the spent means per single road would represent good information and base for the development of the costs simulation and the necessary organisation, which would be significant in making decisions in road maintenance management.

Since in the period from 2001 to 2010 substantial means were invested in road maintenance, the question is whether there is knowledge about the change of status, value and service life of road usage in that period, that is, whether the effects of the invested means have been measured. According to all the studies it is recommended to invest 2 to 2.5% of road value annually into road maintenance, so that according to this criterion, 50% of the means have been invested in the state roads.

The means invested into "emergency" maintenance, which prolongs the roads service life, should be recorded in the accountancy in a way which would really show the change in the road value, which is shown in Chapter 4 of this article.

3. DEFINITION AND METHODS OF DEPRECIATION

According to the Regulations on Depreciation [7] an annual depreciation amount is calculated on the fixed assets. Depreciation is gradual time and physical decrease in the value of fixed assets, and the purpose of calculating depreciation is the accumulation of the means for the replacement of the worn-out item by a new one, in order to constantly maintain the technological and technical level of the operating capacity.

The depreciation means should be used in accordance with the investment plan for the spare fixed assets. The depreciation calculation methods are divided into two basic groups:

3.1 Time methods of depreciation

The time methods of depreciation include linear method, degressive method, and progressive method.

3.1.1 Linear method

Linear (proportional) method of depreciation assumes that fixed assets during the service life undergo uniform wear, and therefore the depreciation expenditure is distributed into relatively equal annual amounts.

3.1.2 Degressive method

The degressive method of depreciation assumes that fixed assets are worn out most during the first years of service, so that for this method the depreciation expenditure in the first years is the highest. The degressive method is implemented in two ways:

a) by applying fixed depreciation rates on the book value of fixed assets which declines from year to year (method of declining base),
b) by applying different declining depreciation rates on the fixed base, that is, the purchase value of fixed assets (method of the sum of years or digital method).

The depreciation at fixed rate reduces the book value of the equipment every year by the same percentage, but not from the initial value of the equipment but rather from the book value of the equipment from the previous year. In the method of the sum of the number of years the depreciation for a single year is calculated by multiplying the quotient of the remaining years and the year-number-sum by the difference of book value and the written-off value (sum of the number of years is the sum of the arithmetic sequence 1, 2, ... n, where n is the number of depreciation years). The year-number-sum method belongs to the group of accelerated depreciation methods

3.1.3 Progressive method

The progressive method of depreciation assumes that fixed assets in the first years of usage are spent the least, so that the amount of depreciation in the first years is the lowest.

3.2 Functional methods of depreciation

Unlike time methods the functional method of depreciation is based on the level of usage of the fixed assets. It can be applied when assets expenditure can be expressed in natural units (machine working hours, travelled kilometres, produced quantity, etc.). Therefore, this method is also called the method of depreciation according to performance. In this method the annual depreciation is calculated by putting the purchase value into relation with the estimated annual effect expressed in natural units.

4. INTERDEPENDENCE BETWEEN THE VALUE OF ROAD INFRASTRUCTURE AND DEPRECIATION

The research has been carried out on the data about state roads in the Republic of Croatia, and the road investment structure in the period from 2001 to 2008 was studied in comparison with road depreciation. Road investment structure was studied through providing for investments and through investing into regular and emergency road maintenance. The objective of research was to study the interdependence of the depreciation amount and the amount for investing into emergency road maintenance.

4.1 *Value of roads*[2]

The road value is registered as long-term material assets in bookkeeping register of legal persons who control and manage the public roads, and the Republic of Croatia is entered as the owner of the proportional part of capital (Act on the Execution of the State Budget of the Republic of Croatia for the year 2009) [9].

The latest estimate of the value of public roads in the Republic of Croatia was done by the Department for Roads of the Croatian Institute of Civil Engineering (IGH) from Zagreb, and the estimate encompassed all the public roads in Croatia. The total estimated value of all the public roads [10] amounted to 239.2 billion kuna. Out of this amount, 81.2 billion kuna or 34% referred to state roads (including also motorways), 158.1 billion or 66% to county and local roads.

The value of roads is not an indicator used for measuring the performance of the road management system in Croatia, nor for strategic planning and means allocation, and it is recorded as long-term material assets in bookkeeping records of legal entities that control and manage public roads. Since the roads as construction object have their economic service life the depreciation rate is determined which allows gradual accumulation of financial means for the replacement of the worn part of the construction object by a new one[3]. However, road functionality is conditioned not only by the service life but also by the intensity of its usage, and it is not sufficient to base the decisions on the statements of statically oriented analysis of the write-off value[4] but rather the analysis has to be expanded to the analysis of the change in the status of long-term assets during a certain period. The Croatian Standards of Financial Reporting (Hrvatski standardi financijskog izvještavanja - HSFI) [11] regulate that the "depreciation method applied to assets shall be restudied at least at the end of every business year and if there is significant change of the expected frame of spending the economic benefits in these assets, it should be changed in order to reflect the frame changes".

Item t.6.44 of HSFI 6 regulates that the "rest of the value and the service life of the assets shall be reanalysed at least once at the end of every year".

The analysis of the change in status is implied in the decisions or the policy of maintaining the capability and functionality of the road so that the road condition analysis should identify the characteristics of the maintenance policy or more precisely the policy of investment maintenance. The analysis of the level of maintaining the capability of material investments, i.e. long-term assets is oriented to the knowledge and assessment of the condition at a certain moment and the causes of such condition. The value of long-term assets is reduced also because of the neglect of investments for the replacement and maintenance of functionality so that the analysis should take into consideration the requirements for maintaining functionality and value compensation. Croatia should certainly pay more attention in the future to the issue of depreciation and road value, since these two categories had

Table 3 - Structure of road investments – 2001 to 2008 (million kn)

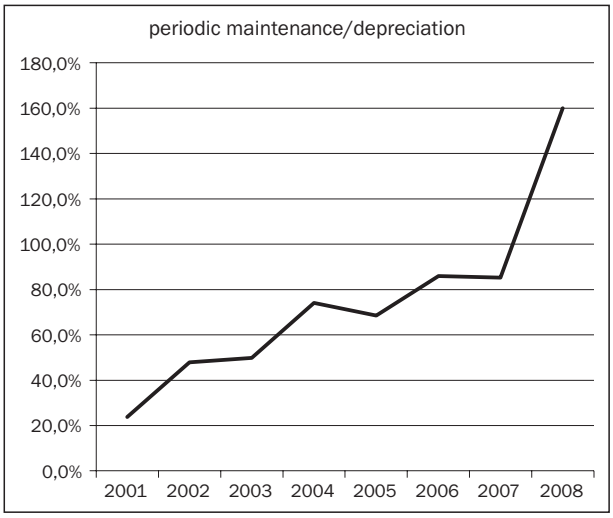
Description		Plan	Realisation	% of realisation	structure
Total		53,860	65,676	121,9%	100.0%
1.	Investments	38,402	50,479	131.4%	76.9%
2.	periodic maintenance	5,859	7,257	123.9%	11.0%
3.	Regular maintenance	9,599	7,940	82.7%	12.1%

Source: Gospodarenje javnim cestama u RH (Public Road Management in Croatia), Miljković, G., Bratković, G., Krleža, J., Journal „Ceste i mostovi"-Via Vita, No. 2, 2010

been rather neglected up to now as instrument for any decision making.

The indicators of road system performance indicate the development of a system which integrates the accountancy and financial information with the condition of road technical characteristics. The system as such becomes the basis for making long-term decisions about the investment in the construction and maintenance of road infrastructure, recognising in this the wishes of the users and macro-economic possibilities of the state.

Research results of correlation between the amount of depreciation and investment into emergency maintenance have shown that the investment amount is at the level of 74% of the depreciation amount[5], which indicates an underestimated depreciation rate regarding the fact that roadway condition assessments are not in compliance with such investment (about 50% of state roads network is not in good condition according to the latest roadway condition measurement from the year 2009).



Graph 3 - Ratio between emergency road maintenance and road depreciation amount

Source: FINA and Hrvatske ceste d.o.o. (Croatian Roads), authors' calculation

4.2 Proposal of the model of investment in road maintenance as preservation of road infrastructure value

By determining the major components of the road that have to be replaced or renewed within defined time intervals, and by defining their service life and depreciation rate, a model of investing into the emergency maintenance and road reconstruction is set. Consequently, by determining the elements which are major sections of the road and have different service life than the service life of the means to which these are related, they need to be kept as separate means and to be depreciated separately, and the subsequent costs that occur due to replacement of these parts are registered in the value of the road according to the International Accounting Standards (Međunarodni računovodstveni standardi - MRS) 16 [12] and HSFI T.6 and pursuant to Art. 80 and Art. 81 of the Regulations on Public Roads Maintenance and Protection. Naturally, the life cycle for every road, i.e. for every road element is not equal, since it depends on the dimensioning of the roadway structure, traffic, geographic conditions, climatic conditions, current physical state of the assets, history of maintenance, future conditions and strategy of maintenance.

The analysis of the level of maintaining the capability of material investments, i.e. of long-term assets, is directed towards the knowledge about and estimate of the state at a certain moment and the causes of such condition. The value of long-term assets is reduced and it ages due to the neglect of investments for the replacement and maintenance of functionality so that the analysis needs to recognise the requirements for maintaining functionality and value compensation.

When referring to the replacement of the major parts of equipment that are not kept as separate means, MRS 16 requires a special procedure of recognising the cost of replacement in the book amount of the means. In such case, it is necessary to estimate the non-depreciated amount which refers to the replaced part of the means and this value is to be subtracted from the cost of replacement, which means that in the book amount of the means only the difference between the cost of the part replacement and the estimated non-depreciated value of the old part that had been written off before the expiry of the service life of the means will be registered. Therefore, a model of investing into road maintenance has been developed for the preservation of the public assets value presented in *Figure 1*.

Furthermore, the application of the functional method of depreciation would be more adequate for the calculation of road value reduction, i.e. its wear when wear would be determined in some natural units such as e.g. the travelled kilometre per vehicle structure. This method is also called the method of depreciation according to performance. In case of this method the annual depreciation is calculated so that the purchase value is interrelated with the estimated annual performance expressed in natural units.

The inventory of road assets should be made, i.e. it is necessary to:

- determine the physical state of the assets, and carry this out within a certain period of time,
- determine per all roads the changes during the period of time: purchase value, value correction, current value, reconstruction value, and values of (new) constructed roads,

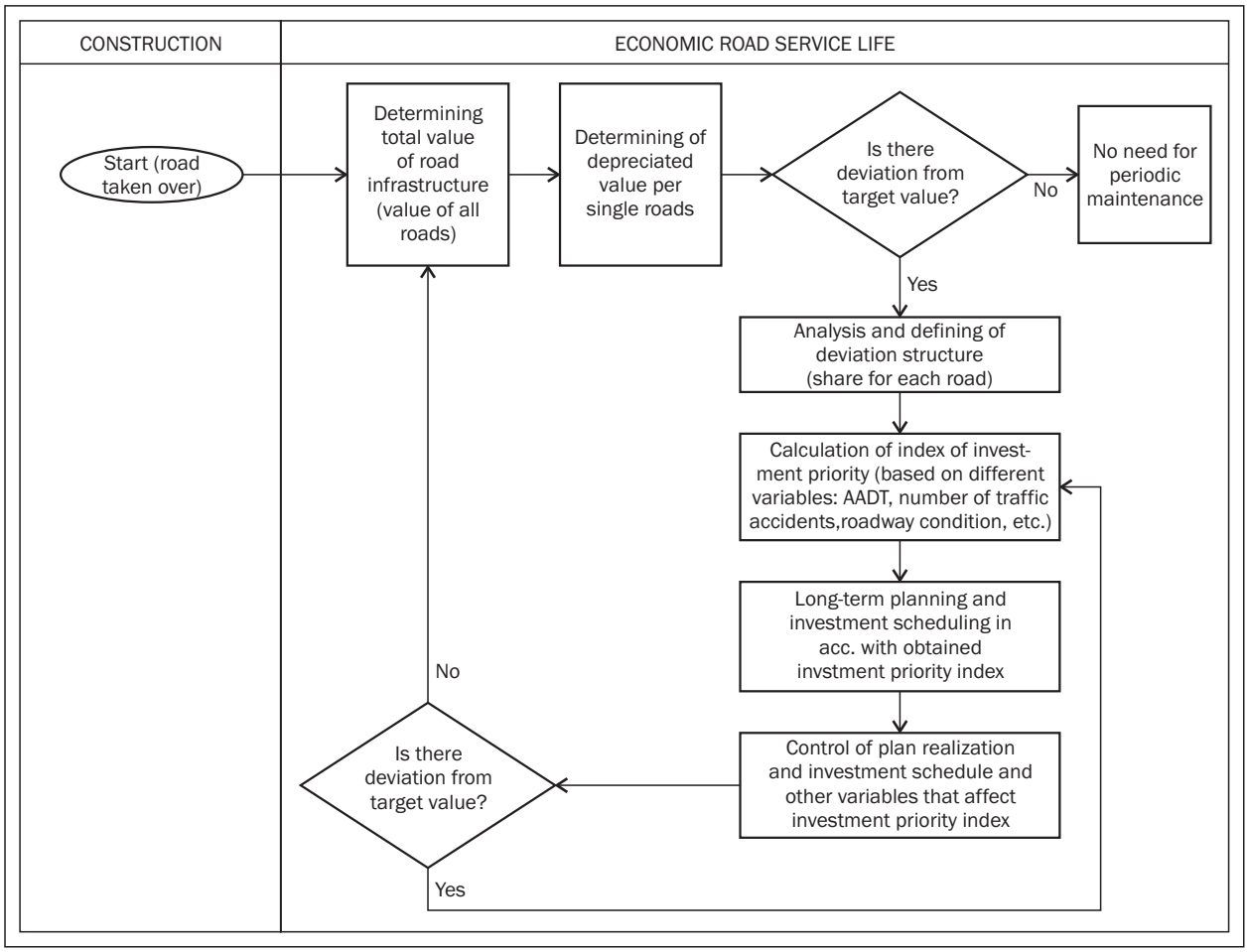
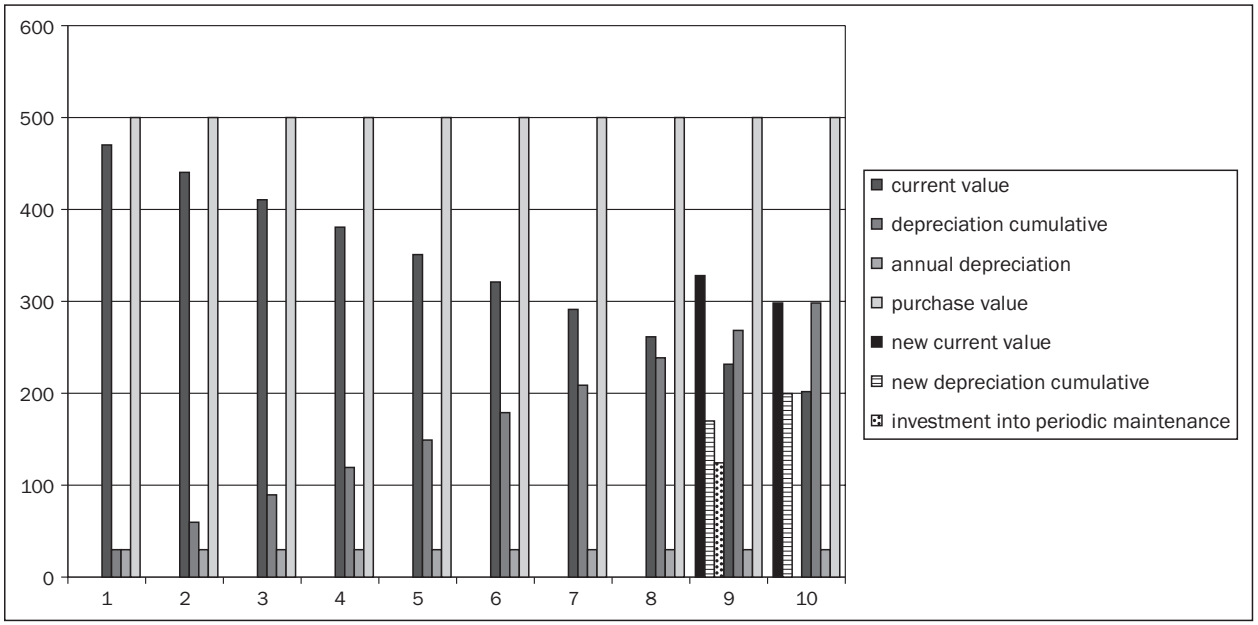


Figure 1 - Model of investing into road maintenance in order to preserve public assets value



Graph 4 - Graphical presentation of the increase in road value by investing into emergency maintenance (connection Table 4)

- harmonize the book account and physical condition of assets and determine the new service life,
- determine the depreciation rate and method,
- determine the major road elements, determine their service life and make a simulation of the future reconstruction costs,

Table 4 - Example of road value calculation

description	years									
	1	2	3	4	5	6	7	8	9	10
present value	470	440	410	380	350	320	290	260	230	200
cumulative depreciation	30	60	90	120	150	180	210	240	270	300
roadway	25	50	75	100	125	150	175	200	225	250
wearing course	12.5	25	37.5	50	62.5	75	87.5	100	112.5	125
base course	12.5	25	37.5	50	62.5	75	87.5	100	112.5	125
equipment	5	10	15	20	25	30	35	40	45	50
road bed	0	0	0	0	0	0	0	0	0	0
depreciation total	30	30	30	30	30	30	30	30	30	30
roadway depreciation	25	25	25	25	25	25	25	25	25	25
wearing course	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
base course	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
equipment depreciation	5	5	5	5	5	5	5	5	5	5
road bed	0	0	0	0	0	0	0	0	0	0
purchase value	500	500	500	500	500	500	500	500	500	500
roadway	250	250	250	250	250	250	250	250	250	250
wearing course	125	125	125	125	125	125	125	125	125	125
base course	125	125	125	125	125	125	125	125	125	125
equipment	50	50	50	50	50	50	50	50	50	50
road bed	200	200	200	200	200	200	200	200	200	200

Table 5 - Calculation of road value (present value of road after investing into emergency maintenance in the 9th year)

	1	2	3	4	5	6	7	8	9	10
present value	470	440	410	380	350	320	290	260	330	300
cumulative depreciation	17.5	35	52.5	70	87.5	105	122.5	140	170	200
roadway										
wearing course	0	0	0	0	0	0	0	0	12.5	25
base course	12.5	25	37.5	50	62.5	75	87.5	100	112.5	125
equipment	5	10	15	20	25	30	35	40	45	50
road bed	0	0	0	0	0	0	0	0	0	0
depreciation total	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	30	30
roadway depreciation										
wearing course									12.5	12.5
base course	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
equipment depreciation	5	5	5	5	5	5	5	5	5	5
road bed	0	0	0	0	0	0	0	0	0	0

– register the costs of emergency maintenance on the basic means and thus increase the road value.

Article 5 of the Regulations on the Maintenance and Protection of Public Roads says that maintenance is performed on the basis of an annual maintenance plan which contains the presentation of the existing road condition at the beginning of the planned period and the presentation of the expected condition at the end of the planned period regarding the existing condition and the planned investments. Planning of investments based on road condition is certainly an objective that requires a good base of road data and in interaction with the accounting data on roads it would represent a good model of managing the complex road system.

For the sake of simplicity the depreciation rate of 10% for the mentioned basic road elements has been assumed, and the purchase road value, depreciation, cumulative depreciation and current value at the end of every observed year has been presented. By writing off of the replaced road element, the correction of its

value is removed from register, and the bookkeeping current road value is increased

In the same manner as road depreciation causes numerous dilemmas, so is the accountancy recording of emergency maintenance always questionable, and in legal parties that manage and operate the road network very different, since no joint methodology has been determined. However, the fact that emergency maintenance prolongs the road service life and that in its essence it increases the road value is not questionable.

5. CONCLUSION

The depreciation of public assets as an economic category did not have until now its function. By introducing the ne w system of national accounts ESA 95, one of the most significant changes in relation to the previous ESA 79 is precisely the liability to calculate the depreciation of public assets. The emphasis on the value of national assets opens up a completely new chapter in the evaluation of the national capital and will certainly result in numerous discussions and solutions in defining and preserving the public assets values. Since the users of roads (except for motorways) do not pay toll for road usage which is proportional to their benefit, a certain financing model should provide compensation of the spent road value. The model and methods of depreciation calculation should be determined according to the actual road service life, which would result in the knowledge about the needs for investing into the preservation of its value.

As economy category, road depreciation has to be precisely defined and integrated into the general economic model of road infrastructure control and management. Apart from conceptual definition adequate organisational assumptions need to be created, that is, the carriers need to be determined as well as the calculation methods and the allocation of the means.

The issue of road depreciation has always raised dilemmas; therefore this paper represents only an incentive for the discussion about the future role of depreciation and the future method of calculating road depreciation, mainly since this will certainly be required by the application of ESA 95.

The answer to the question whether the depreciation amount will represent the base for the planning of future investments or whether the implementation of the functional system of depreciation calculation is indeed more adequate in road infrastructure, should be provided by detailed processing of empirical data and the simulations that will show the effects of different methods of calculation.

Therefore, the issue of public road depreciation is to become one of the tasks in the future period, since the information about the actual value of public assets is of great significance.

The guidelines for further research include identification of the optimal model of using the road infrastructure value as the basis of strategic planning of investments and investment maintenance of road network.

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SAŽETAK

MODEL ULAGANJA U ODRŽAVANJE CESTA U FUNKCIJI OČUVANJA VRIJEDNOSTI CESTOVNE INFRASTRUKTURE

Cilj istraživanja bio je ukazati na neiskorištenost informacije o amortizaciji cesta u procesu donošenja odluka o ulaganju u održavanje cesta. Amortizacija kao računovodstvena kategorija nije dovoljno iskorištena kao upravljačka informacija i status joj je marginaliziran. Veliki problem je i nedefiniran status „izvanrednog" održavanja, kojeg neki pravni subjekti zaduženi za upravljanje cestama knjiže kao investicijsko održavanje kojim se nadoknađuje vrijednost ceste, a neki kao trošak, te u tom slučaju navedena ulaganja niti ne ulaze u osnovicu za obračun amortizacije.

Prilikom izrade ovoga rada pratili su se podaci o knjigovodstvenoj vrijednosti ceste, iznosu amortizacije i podaci o ulaganjima u održavanje na državnim cestama u razdoblju od 2001. do 2008. godine.

U analizi podataka primijenjena je metodologija deskriptivne statistike i regresijske analize.

Rezultati istraživanja korelacije između iznosa amortizacije i ulaganja u izvanredno održavanje pokazali su da je iznos ulaganja na razini 74% iznosa amortizacije, što ukazuje na podcijenjenu stopu amortizacije s obzirom na činjenicu da ocjene stanja kolnika ipak nisu sukladne takvom ulaganju.

KLJUČNE RIJEČI

amortizacija ceste, izvanredno održavanje, vrijednost ceste, upravljanje cestama

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2. Public roads consist of:
   – road building (road foundation, roadway bed, pavement structure, bridge, viaduct, underpass, overpass, culvert, tunnel, gallery, retaining and revet-

ment wall, embankment, pedestrian underpass and overpass),
- facilities for road drainage and water filtering,
- land area on both sides of the road necessary for easy road maintenance, of the width according to road design, at least one metre calculating from the line which connects the end points of the road cross-section,
- air space 7m above roadway,
- road land covering the area consisting of land on which the road facility should be or has been built according to the project, land zone area and area of land on which according to the project the roads have been built or facilities for road maintenance and provision of services for drivers and passengers as well as toll charging according to the road project should be built (facilities for road maintenance, traffic management and control, toll charging, petrol stations, services, parking lots, resting areas, etc.)
- facilities on road land, for the road maintenance requirements and provision of services to drivers and passengers, and toll charging, planned by the road project,
- stable measuring structures and devices for vehicle control,
- connections to public road built on road land,
- traffic signs and instruments for control and safe guidance of traffic and road equipment (traffic signs, lighting instruments, telecommunication steady instruments, installations and lighting in the function of traffic, road markings, traffic detector-counters, installations, instruments and equipment in tunnels, equipment of parking lots, resting areas, etc.)
- facilities and equipment for protection of roads, traffic and environment (snowbreaks, wind screens, protection against taluses and drifts, protective and safety fences, protection against noise and other harmful impacts on the environment, etc.).

3. There is not one document which regulates that the investment amount in road maintenance has to be equal to the depreciation amount
4. The expressed written-off value in the balance results from the calculation of depreciation and need not be actual reflection of the reduced and spent value
5. Average for the period from 2001 to 2008

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